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Reply To: 3420

Date: Sept. 30, 1994

Subject: Oak pests at Descanso Fire Station, Descanso Ranger District (FPM Report No. S94-1)

To: Forest Supervisor, Cleveland National Forest

Descanso Ranger District Resource Officer Deb Deppe sent specimens of damaged branches, foliage and bark from large live oaks (Quercus agrifolia) growing at the Descanso Fire Station. Bark from the bole of one tree had tunnels of flatheaded borers. Identification of these insects would require specimens of the adults, and the age of the insect damage on the bark sent to me precludes more than a guess that a deleterious flatheaded borer was present. One such borer that infests native oaks is the Pacific flatheaded borer, whose larvae mine the cambial region of large limbs or the main trunk. In cases where the mines girdle the trunk or limb, the portion of the tree apical to the larval gallery is killed.

The foliage and branches also had evidence of several minor oak pests, including twig girdlers, bark beetles, leaf miners, and other insects (see enclosed). Most of these pests are not a threat to the overall health of the tree. Although they rob the tree of photosynthetic tissue, in the process they may also decrease the water needs of infested trees by removing actively transpiring plant parts.

Large old oaks in southern California often suffer from heart rot, which would not have been seen in the specimens sent to me. Depending on the architecture of the individual tree and the proximity of people (e.g. location of picnic tables) or property (buildings or vehicles), such trees may present a high risk and should be pruned or even cut down if the threat is significant. Alternatively the "target" (picnic site or parking) can be moved. Often the heart rot, if present, can be seen in cut branch stubs or basal wounds on the tree. Sometimes the only evidence is the presence of fungal fruiting bodies (conks) on the trunk.

Good management of specimen oaks in landscape situations includes preventing soil compaction in the root zone, which extends well beyond the drip line of the trees, pruning out of mistletoe brooms, and preventing mechanical damage to the trunk and roots. Watering of native oaks should be done cautiously, if at all, as frequent watering of the surface soil (such as in a lawn) can make the trees susceptible to root decay fungi. It may be helpful to water the trees during drought years or at times when the root systems have been damaged by construction activity. The trunk and the area within several feet of it should never be watered. Watering should moisten the soil to a depth of 3 feet. This can be accomplished by running a soaker hose for 2-3 days. Watering should be done during the cool season (e.g., in the early spring). See the enclosed leaflet on irrigating native oaks for other information.

Please call me at (909) 884-6634 ext. 3199 or James Allison, Pathologist, at ext. 3123 if you have any further questions or wish for us to make a site visit and inspection of these trees. In addition to the leaflet on irrigation of oaks I have enclosed a California Department of Forestry leaflet entitled, "Keeping native California oaks healthy" and some information on the insect pest damage observed on the specimens sent to me.

Sincerely,

Laura Merrill

Laura Merrill, Entomologist
Forest Pest Management
Southern California Shared Service Area

cc: District Ranger, Descanso Ranger District
Program Leader, Forest Pest Management, Regional Office

enc.

The Pacific flatheaded borer, Chrysobothris mali (Coleoptera: Buprestidae)

The Pacific flatheaded borer attacks 70 or more species of woody plants and is considered one of the worst enemies of newly planted deciduous trees and shrubs on the Pacific slope. Well established plants which have been subjected to disturbance (such as drought, pruning, sunburned areas on the trunk or limbs or other injuries) are subject to attack.

The female beetle deposits her eggs in cracks in the bark. The eggs are about 1 mm in diameter and yellowish white, and are not normally seen. Upon hatching, the legless larva bores through the eggshell and bark into the phloem (the nutrient conducting tissue) and the active xylem (sapwood). If the tree is vigorous the larva may be ejected and killed by sap. Otherwise, the larva bores a meandering gallery, packing it with frass in a distinctive, arc-like pattern. The gallery may cause large areas of tissue to die, and overlapping galleries may girdle the trunk, causing death of the tree, or spiralling galleries may girdle limbs. The mature larva bores into the heartwood to pupate. Adults may be found from April through August, but most emergence occurs in June and July. At lower elevations there is one generation annually, but at higher elevations the life cycle may require more time.

The yellowish white larva is shaped like a horseshoe nail. The widest part is the sclerotized (hardened) prothorax, into which the head is sunk. The meso- and metathorax are progressively narrower, followed by the abdomen, which is even narrower and beadlike. The adult beetle is 6 to 11 mm long, dark bronze to reddish-copper colored, with distinct copper colored spots on the elytra (forewings).

The first symptom of attack may be a wet spot on the bark. Later the bark over the mined area cracks and peels. If a larval mine or overlapping mines girdle a branch or the trunk, the portion of the plant apical to the infestation site will die.

Although this insect has natural enemies, they are not effective in controlling it. The best option for preventing damage from the Pacific flatheaded borer is to keep trees in as vigorous a condition as possible and avoid injuring them. On high value trees it may be possible to prevent extensive damage by cutting the young larvae out with a sharp knife. The trunks of young nursery stock may be wrapped with several thicknesses of suitable material the first year after they have been planted.

Oak bark beetles, Pseudopityophthorus spp. (Coleoptera: Scolytidae)

Two species of Pseudopityophthorus, P. agrifoliae Blackman and P. pubipennis (LeConte), are known to infest oaks in California, and both occur in coast live oak and other species. They feed in the phloem of trunks and branches. S.L. Wood (1982) gives the distribution of the former as California and Arizona, and the latter, California and Oregon. These are small and inconspicuous insects, and it is likely that the host and geographic ranges are not fully known. These bark beetles are secondary pests that attack trees

weakened from other causes. Heavy attacks on the trunk can hasten the death of the tree.

The male beetles initiate galleries in cut, broken or unthrifty branches, limbs, or boles. The male is normally joined by two females who tunnel transverse egg galleries in opposite directions. The larvae tunnel at a 90 degree angle away from the egg gallery constructed by the female, and thus run parallel to the branch or trunk. The adult galleries are kept clear of frass, while the larval galleries are packed with fine sawdust. Both the adults and larvae feed in the phloem. Prior to pupating, the larvae tunnel up into the bark. P. pubipennis, at least, has 2 or more generations a year. There is much to be learned about this genus of beetles.

Adults of these two Pseudopityophthorus spp. are dark brown and 1.5 - 2.5 mm in length. They are almost 3 times as long as they are wide. The larvae are tiny, pale, legless grubs.

Presence of these beetles is usually indicated on dead branches or other material by the presence of pin sized "shot holes" in the bark. These are caused by the emerging adults. If the bark is removed, the distinctive galleries can be seen.

Keeping trees in vigorous growing condition is the most feasible means of preventing attacks of these beetles. Because attacks usually occur on broken branches, etc., it would rarely be economical to prevent attacks by applying pesticides to the trunk of the tree.

Oak twig girdler, Agrilus angelicus (Coleoptera: Buprestidae)

Under conditions of drought, this flatheaded borer has been called the "number one oak pest in southern California" (Brown and Eads 1965). Damage is usually seen as clumps of dead leaves scattered throughout the crown. Coast live oak, Quercus agrifolia, is affected more than other oaks, although interior live oak, Engelmann oak, and several introduced oaks are also susceptible to damage by this insect.

The adults emerge from May through September. The female beetle lays her eggs singly on oak twigs. The eggs are inconspicous and difficult to see. The hatching larva bores directly through the bottom of the eggshell into the sapwood of the twig. For the first 3-6 months, the larva bores a linear mine in the direction of the older twig growth, tunneling just below the bark. This gallery extends a few inches, and causes almost no outward symptoms of infestation. The larva then begins mining a spiral gallery around the twig. As the weather warms up, the few leaves apical to this mine die and damage becomes noticeable. During the next season the larva continues this spiral gallery for a foot or more down the twig, resulting in the death of many more leaves and twigs. The larval stage continues for approximately 22 months and girdles twigs up to 1/2 inch in diameter. The larva then turns toward the center of the twig and mines up to 6 inches back into the previously killed tissue, hollowing out a pupal cell at the end of this mine. The adult gnaws its way out of the twig and the cycle begins again. Although the life cycle takes two years, there are alternating generations, thus adults are present every year.

The adult oak twig girdler is 5-7 mm long and a little less than 2 mm wide. The head and pronotum are a dark brownish copper and the elytra are darker. The larvae are glistening white, 18 - 25 mm long when full grown.

Infested trees have scattered clumps of dead foliage. The affected twigs should be examined for the types of galleries described above to confirm the presence of these beetles. The damage is cosmetic and may actually benefit the tree in times of drought by removing foliage which would otherwise be transpiring water. On high value trees the dead twigs can be pruned out for aesthetic reasons. In the past, oaks have been sprayed with long lasting pesticides prior to adult emergence to protect them from attacks by this insect.

Roundheaded oak twig borer, Styloxus fulleri (Coleoptera: Cerambycidae)

The damage caused by the roundheaded oak twig borer is very similar to that of the oak twig girdler. Dead twigs are scattered through the crown, but dissection of an affected twig reveals a large, broadly oval, frass-filled gallery going down the center of the twig. This insect may be responsible for as much as 30% of the damage attributed to the oak twig girdler. Both coast and interior live oaks are hosts.

Adults emerge April to September. The life cycle is not known but is believed to take two years.

The larva is a glistening deep yellow color, with the head deeply sunken into the enlarged prothorax. Adults are 10-18 mm long (average 13 mm) and quite slender.

Symptoms of attack and control of this insect are similar to those for the oak twig girdler. The damage is cosmetic and is unlikely to warrant chemical treatment.

Lepidopterous oak defoliators

There are many moth larvae which feed on oak foliage in southern California. Most occur in low numbers most of the time and have little impact on the health and vigor of the trees. When defoliators occur in high numbers they may harm or benefit trees, or both. Repeated heavy defoliation of trees may debilitate them to the point where other insects, such as the Pacific flatheaded borer and oak bark beetles, can successfully attack and kill the trees. Some defoliation may be beneficial, by removing actively transpiring tissues in times of drought, and by recycling nutrients tied up in older, less photosynthetically productive leaves.

What follows are brief descriptions of the species likely to occur in damaging numbers. Not included are several leaf tiers and leaf miners which are less common than the species listed below.

The California oak worm, Phryganidia californica (Lepidoptera: Dioptidae) is cited by Brown and Eads (1965) as perhaps the most important insect

affecting oak in nondrought years (which is not to imply that this insect is not also capable of defoliating oaks in drought years). This insect is primarily a pest of live oaks, as it is unable to overwinter on deciduous oaks (overwintering larvae feed on warm days). Development from egg to adult requires 15-29 weeks, depending on weather. All insect stages are present throughout most of the year. Brown and Eads found 5 peak adult moth flight periods.

The adult of the California oak worm is a uniform light brown color, with darker wing veins. The wingspan is 25-35 mm. Adults fly during the day and evening and are commonly seen fluttering weakly around the host trees. The nearly spherical eggs are laid in groups on the leaves, each egg is ca. 1 mm in diameter. The mature larvae are 25 mm long, lack conspicuous hairs, black with prominent yellow and indistinct red longitudinal stripes on the dorsum and lower part of the sides. The naked pupae hang by hooks on the caudal end, and are whitish or yellowish with black, yellow and red markings.

Early instar larvae skeletonize the oak leaves (feed on soft portions between the veins, leaving one leaf cuticle intact). Larger larvae consume all but the largest veins, beginning at the leaf margins.

The fruittree leafroller, Archips argyrospila (Lepidoptera: Tortricidae), is an important defoliator of California black oak and, to a lesser extent, coast live oak and interior live oak in southern California. This insect attacks many hardwoods throughtout the U.S., and it is likely that it is actually a complex of species or subspecies. The form found on oak trees in southern California does not appear to attack pome fruits, for example. Although the taxonomy of the group is poorly understood, the life cycle is well known.

Eggs are laid in irregular flat masses on twigs and branches. These masses of 50 - 100 eggs are covered with a whitish cement and are the overwintering form of the insect. In the spring the larvae chew their way out and move to the leaves. The edge of the leaf may be rolled over and tied with silk thread to form a protected cavity in which the larva feeds, or portions of two adjacent leaves may be tied together for the purpose.

At maturity the larva may be 20-25 mm long, light green, with a shiny black or brown head and prothoracic shield. The pupa is ca. 11 mm long, light to dark brown, and is located in the nest made by the larva. The small, inconspicuous adults have a wingspan of 20-25 mm and are mostly fawn or rusty brown, with a splotchy appearance to the wings. The adults typically do not fly during the day except when they are disturbed. Seen from above, adults at rest are bell shaped. Adults may be present from May to August.

There is one generation a year, and some populations go into spectacular outbreaks every several years. Certain areas, such as the vicinity of Lake Gregory in the San Bernardino Mountains, maintain moderate populations at all times, even when populations elsewhere are quite low and difficult to find. When the insect is in outbreak, large areas may be defoliated and the trees appear gray at a distance from the loss of foliage. Fruittree leafroller populations were in outbreak in 1992 and 1993 in the San Bernardino Mountains, and in moderately high levels in 1994 in the Mendenhall Valley on the side of

Mt. Palomar. Oil may be applied to the egg masses for control in the winter, or the foliage may be sprayed in the spring with a pesticide such as Bacillus thuringiensis. Timing of the latter is critical, and this pesticide should be applied when 25% - 50% of the eggs have hatched. A high pressure applicator may be needed to penetrate the rolled leaves. In a wildland situation it is rarely desirable to control this insect. Rather, treatment should be reserved for high value trees, such as landscape trees.

Tent caterpillars, Malacosoma spp. (Lepidoptera: Lasiocampidae), are occasionally found in epidemic numbers on live and deciduous oaks in southern California. These insects also feed on other hardwoods. The two species found on our oaks are M. californicum, the western tent caterpillar, and M. constrictum, the Pacific tent caterpillar. Larvae of both species feed gregariously, but differ in their tent-making. The western tent caterpillar larvae make substantial silken tents in which they rest between feeding periods, while the tents made by the Pacific tent caterpillar are much smaller and more rudimentary. When either species is present in large numbers, tree growth may be impaired by the heavy defoliation, and aesthetic values may be affected.

These tent caterpillars overwinter as eggs, which are laid around the twigs in dark, frothy masses. Larvae of both species are quite hairy and dark, differing in coloration. The western tent caterpillar has very little blue but an orange line between the most dense hair tufts on the side. The Pacific tent caterpillar has much more blue, and a small orange spot between the lateral hair tufts. Mature larvae are 35 mm long and pupate within a tough silk cocoon in which larval hairs are incorporated. The adult has a 24-27 mm wingspan with the body thickly covered with long, light brown to reddish brown furlike hair. Adults fly April - July. There is one generation a year.

The damage caused by tent caterpillars in a wildland situation would rarely warrant control treatment. The tents and associated caterpillars can be pruned out of high value trees, or treated with pesticides such as Bacillus thuringiensis.

The western tussock moth, Orgyia (formerly Hemerocampa) vetusta (Lepidoptera: Lymantriidae), feeds on oak, poplar, willow, deciduous and citrus fruit trees, walnut, hawthorn, manzanita, pyracantha and toyon. The western tussock moth can cause serious defoliation over a large area. The rosaceous hosts (pome fruits, pyracantha, etc.) are preferred over oaks.

In southern California the western tussock moth has two generations a year, or one and a possible partial second generation (Brown and Eads observed larvae feeding March-May and August-October). In more northern areas there is one generation a year. The eggs are laid on the female's cocoon or on the bark of larger branches in a mass covered with hairs from the female. Often the female remains on the egg mass. The mature larvae are black and with numerous brightly colored red and yellow spots; each red spot has long gray-white hairs growing out of it. There are four striking white tufts of hair on the back, one posterior dorsal tuft of gray hairs, and two long black anterior tufts and one posterior black hornlike tuft. Pupation is in silk cocoons which have many larval hairs incorporated in them. The adult female is covered with long

pinkish-gray hair, has vestigial wings and is flightless, while the nocturnal male has a 20-27 mm wingspan and is brownish with grayish-white and dark brown markings.

It is unlikely that control in a forest situation would ever be justified except for high value landscape trees. Should control be needed, pesticide should be applied in early spring while the larvae are quite small.

The saltmarsh caterpillar, Estigmene acrea (Lepidoptera: Arctiidae) is occasionally found in high enough numbers on oaks to cause economically important damage. This usually occurs when the wild meadow vegetation on which it feeds dries out and the larvae migrate to nearby oaks and feed voraciously on the foliage.

The larger caterpillars are the stage which would be encountered on oak. They are ca. 50 mm long when full grown and covered with thick black hair with some brown hair. The adult moths are large with white wings (the hind wings of the male are whitish orange) with scattered black spots. There is evidence that the insect breeds year round in southern California. The larvae are sometimes seen migrating across roads in great numbers.

Control would only be justified for high value trees, and would consist of spraying the foliage with an appropriate pesticide.

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IRRIGATING NATIVE CALIFORNIA OAKS

Summary: Irrigating native California oaks is both unnatural and problematic in most situations. Native oaks are well adapted to the dry summers in California. Warm season irrigation changes the root environment of native oaks dramatically which can lead to premature oak death.

California is renowned for its "Golden Hills" which reflect our dry summer Mediterranean climate. When the root area of native oaks is moistened during the "dry" season, the soil environment is dramatically changed. The resulting warm, moist conditions are appropriate for the development of two groups of parasitic root fungi. As these fungi grow, they consume essential root tissues. This can lead to avoidable premature loss of native oaks.

Oak root fungus (*Armillaria mellea*) is a common native soil-borne fungus. Under natural conditions, such as dry soil during the warm season, this fungus becomes inactive or consumes only dead material. This type of association is called saprophytic, not parasitic. Oak root fungus becomes parasitic only when a susceptible host is present and when the soil environment favors its development.

Another root fungus group is commonly called the water molds. This fungus group, when present, flourishes under saturated soil conditions. The oak root fungus and watermolds, alone or together, can parasitize roots of trees under the right conditions. Both of these fungi weaken their host tree and can kill them.

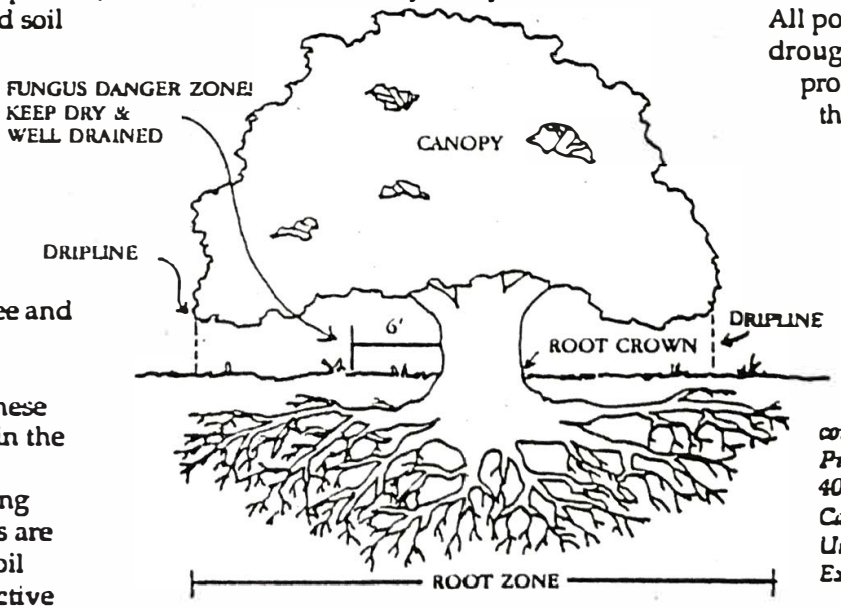
Soil fumigation for these fungi is not realistic in the wild or in landscape situations with existing trees since treatments are lethal oaks plants. Soil fumigation is an effective preplanting fungus treatment, but since it also kills all plants, this method has limited application. Disease management is feasible by changing environmental conditions to favor the tree and discourage the fungi. This includes the elimination of warm season irrigation, reduction of other plant stresses as practical, and enhancement of host vigor.

Shallow watering does not stop the disease complications associated with warm season irrigation of native oaks in California. An appropriate landscape under and near native oaks should utilize drought-tolerant plants, either native or exotic, which do not require summer irrigation. However, these plants compete with the oaks for available water and nutrients.

If warm season irrigation of native oaks is allowed, disease may lead to their premature demise. Diseased trees are a liability. They may die-back slowly, wilt and die abruptly, or fall over when the root system is consumed by decay. Once the soil is contaminated by the proliferation of parasitic root fungi, the survival of other plants in the same area is in jeopardy. The shade-dependent plants previously protected under oaks are not tolerant of the direct sun exposure that results from the loss of the oak overstory. Additionally, there is a limited number of plant species that are specifically resistant to these root fungi. All of these factors limit both existing plant survival and future planting success.

When oaks are stressed by drought, root loss, or compacted soil, irrigation may then be beneficial. In these situations, irrigation should moisten the upper three feet of soil over the entire root zone. The trunk must not be moistened. Water should be applied only during the cool season, except under extreme conditions. If an oak must be irrigated during the warm season to keep it alive, the root zone should be aerated, mulched, and managed for maximum root development.

All points considered, irrigating drought-adapted California oaks is problematic. Irrigation enhances the development of certain parasitic root fungi. The parasitic root fungi consume roots, weakening the health and stability of the host tree. If not treated, diseased trees die prematurely or fall over. Falling trees are a hazard and a liability.



For more information on oaks, contact the Oak Information Project, UC Hopland Field Station, 4070 University Road, Hopland, California 95449, or your local University of California Cooperative Extension Farm Advisor.

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TREE NOTES

CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION

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NUMBER: 7 JUNE 1990

Keeping Native California Oaks Healthy

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Oak trees in the residential landscape are often seriously damaged or killed during the construction and/or landscaping phase of development. Decline and early death may also stem from inappropriate landscaping and irrigation practices. Damage often takes years to become evident, and by the time the tree shows signs of decline it is usually too late to help.

Oaks and Summer Water

Once established, native oaks require little or no supplemental irrigation. In fact, they do best in non-irrigated soils. This is because oak roots, particularly those originating at the base of the trunk (root crown), are susceptible to root-disease fungi when exposed to prolonged moisture during the summer (Figure 1). These fungi are normally inactive in dry soil, but proliferate under the warm, moist conditions created when frequent summer water is applied. (Other species of trees are less susceptible to these fungi because they have evolved where summer soil moisture is high.) Oaks weakened by the loss of roots or root function are particularly susceptible to root pathogens and other pests. Frequent summer irrigation, particularly near the root crown, is likely to cause root decay which, over time, may destroy the roots, killing the tree or causing a hazardous situation. Therefore, irrigation for lawns, ground covers or other ornamental vegetation should be avoided or, at the very least, kept well away from the trunk. The common notion that younger oaks can adapt to frequent irrigation is incorrect. Young or newly planted oaks in irrigated situations often show signs of decline after 15 to 20 years.

Oak Roots

The roots of mature oaks grow predominantly within the upper three feet of soil. Most of the roots responsible for the uptake of water and minerals are concentrated within 18 inches of the surface. Few roots grow deeper than three feet. Although the roots typically radiate well beyond the periphery of foliage (drip line), much of the active root system is within the drip line (Figure 1). Roots are sensitive to environmental change (soil compaction, grade change, increased moisture, paving). Oak roots like those of most trees, are associated with beneficial fungi that resist pathogens in the soil and aid in the absorption of water and minerals. These fungi are easily killed by changes in soil conditions.

Common Problems That Occur During Construction and Landscaping

Life-supporting roots are frequently severed during construction or damaged by other construction practices that change the existing soil environment. The frequent irrigation of lawns and ornamental vegetation commonly planted under oaks after construction, leads to decay and progressive root loss. The net effect is reduced water and mineral uptake. This typically causes die-back and decline over one to many years. Few people associate this decline with construction or landscaping because the symptoms often develop gradually. Most of these trees will die or fall prematurely unless prompt remedial action is taken.

Activities That Damage Roots and Disturb the Soil Environment

Grade change. This involves either the addition or removal of soil within the drip line. Excavation can sever roots, while the addition of fill soil may suffocate them. Fill soils can also impede water infiltration and soil drainage, leading to drought conditions or waterlogging.

Trenching. Trenches dug for utility or irrigation lines within or across the drip line cut essential roots. This impairs the tree's ability to obtain water and essential elements, which may cause death, die-back, or gradual decline. It can also impede drainage and root development.

Pavement. Impermeable soil coverings such as asphalt or concrete restrict the amount of air, water, and minerals available to the roots. This impairs root growth and function, and can ultimately lead to their death.

Soil compaction. Frequent traffic, both human and livestock, and the operation and parking of heavy vehicles within the drip line, squeeze soil particles together, thus eliminating much of the natural air space. This reduces the infiltration and storage of water and air, inhibiting root growth and the uptake of water and minerals.

Drainage changes. Grade changes that cause water to collect around a tree, especially near the trunk, are harmful. Likewise, a grade change that diverts a source of water that the tree depends on may cause drought stress.

Soil contamination. Avoid storing and discarding harmful chemicals or materials such as, herbicides, petroleum products, building materials, or waste water near oaks.

Herbicides. It is best to avoid using systemic or soil active herbicides under landscape trees. If herbicides are to be used within the root zone follow label recommendations.

Root Loss. The degree to which oaks tolerate root loss depends on species, age, health, climate, soil depth, soil structure, and soil moisture. In general, the damage caused by a 15 to 30 percent loss of roots is negligible to moderate, respectively. A root loss in excess of 50% is considered to be harmful. A single three foot deep trench at the drip line along one side of a tree will remove approximately 15 percent of the roots. A similar trench made midway between the drip-line and the trunk will sever approximately 30 percent of the roots. Trenches made within 10' of large oaks are usually very damaging.

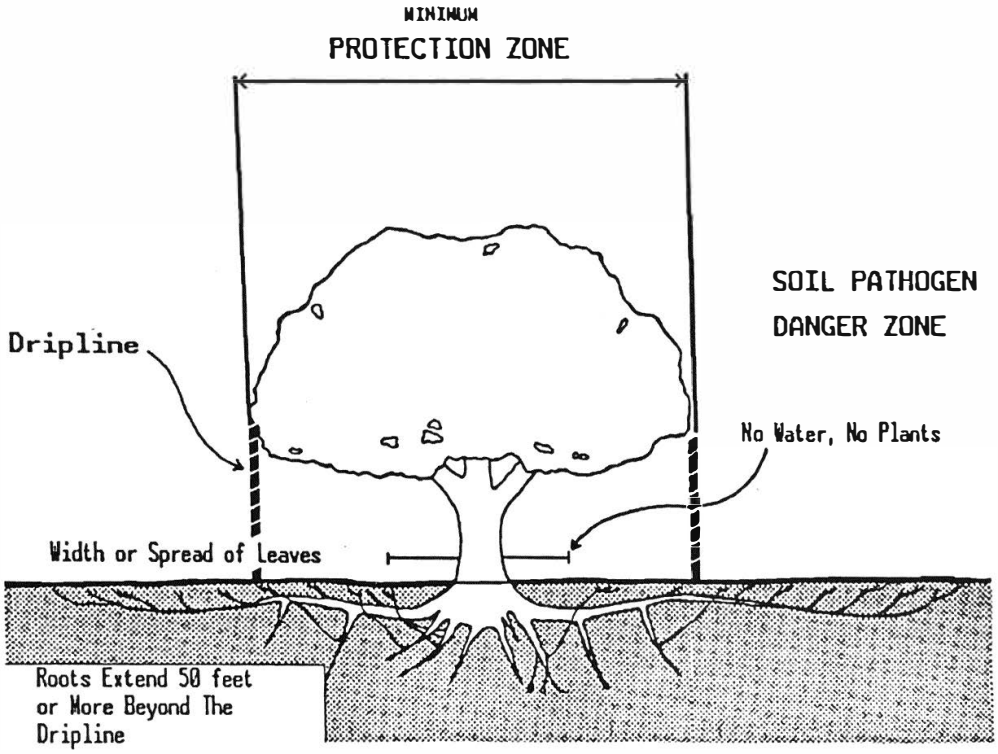

FIGURE 1.

Preventing Problems

Avoid injuring the roots or altering the soil where they grow, particularly within the drip line. Keep this area undisturbed and free of water-demanding ornamental vegetation such as lawns, ground covers, and shrubs like rhododendrons, azaleas, and camellias. Do not remove the leaf mulch unless there is a fire hazard. This organic material conserves water, provides nutrients as it decays, improves soil structure, decreases soil pH, and reduces soil temperature extremes. If turf is present beneath oaks, discontinue watering within the drip zone. If this is impractical, plug, alter or redirect sprinklers to prevent water from hitting the trunk or wetting the soil within 10 feet of the tree's trunk. Although not necessary, you may wish to remove the dying turf. In either case, cover the exposed soil surface or turf with 2 to 4 inches of organic mulch.

Appropriate Landscaping. If ornamental vegetation must be planted under old, established oaks, minimize its use. Keep the area within the drip zone relatively open. Use plants as accents rather than as ground covers. Extensive landscaping will disturb much of the root system and compete for available water and minerals. Select plants that tolerate shade and drought, and plant no closer than 10 feet to the trunk (Figure 1). Avoid all planting under declining oaks. Trees that have sustained construction damage will require several years to recover before landscaping.

Watering. As a general rule, native oaks should not be irrigated. One exception, however, is during drought years. If the winter is unusually dry, supplemental watering in the spring can complement natural rainfall. Water the soil from halfway between the trunk and the drip line to 10-15 feet beyond, allowing water to penetrate the soil to a depth of 18 to 24 inches. It may be necessary to water for 4 to 6 hours to get water to this depth. Keep water at least 10' away from the trunk. The length of time will vary based on the rate of water flow, method of irrigation (soaker hose, sprinkler, etc.), area covered, rate of water penetration, and topography. You

ay have to experiment a little to get good water penetration. To check the depth of penetration, dig a small hole in the irrigated area several hours after watering. If the soil is moist at the desired level, the watering time is adequate. Insufficient watering is marked by dry soil, while excessive watering is indicated by standing water. Additional watering can be applied 1-2 times during especially dry summers. Another exception for the occasional watering of oaks is where extensive use of pavement causes natural precipitation to run off rather than penetrate the soil around the trees, causing drought stress. One further reason to irrigate native oaks, is to reduce water stress following moderate to severe root loss.

Plant drought tolerant landscape plants in the fall and winter to ensure their survival. If rain is lacking, water these plants twice a week for several weeks. Use a drip system or slow running hose to wet the root ball and 4-6 inches of surrounding soil. Thereafter, water twice a month until the rain starts. The following season, water 2-3 times during the summer. Wetting the soil to a depth and radius of 12 incles around the plant. By the third season, most of the plants should be well established, requiring no further watering. If turf is to be maintained under an oak, apply the least amount of water which will keep it reasonably green.

Mulching. Keep the soil surface beneath oaks mulched with 2-4 inches of natural leaf litter, wood chips, or gravel. Be careful not to place the mulch directly against the trunk. Organic mulch will improve soil structure and provide minerals upon decay. Avoid the use of impervious plastic tarping which reduces the availability of air and water to the roots.

Fertilizing. Healthy, mature oaks growing under natural conditions do not normally require added fertilizer. However, oaks in landscaped areas where the leaf litter is regularly removed, will benefit from nitrogen fertilization. Young oaks can be fertilized to encourage rapid growth. The ideal time to fertilize is in the spring. Fertilizer is best applied by broadcasting over the tree's root zone. If rain is lacking, lightly water the minerals into the soil, avoiding the area within 10' of the trunk. Use fertilizers high in nitrogen (N) such as calcium nitrate, ammonia sulfate, ammonia nitrate or urea. Complete fertilizers containing nitrogen (N), phosphorous (P) and potassium (K) are more expensive and generally unwarranted.

Pruning. NEVER TOP OAKS. DO NOT LEAVE STUBS. DO NOT MAKE FLUSH CUTS. PROTECT THE BRANCH COLLAR. Try to retain natural shape. Avoid excessive pruning, remove no more than 10-20% of the foliage in any one year. Except for the removal of weak, hazardous, diseased, damaged or dead branches, mature oaks normally require little pruning. Some trees can benefit from light thinning to open the foliage canopy to more sunlight or to lighten heavy branches. Avoid pruning in the spring and early fall. Pruning large trees is dangerous and difficult; it is best left to professionals. Consult an arborist, preferably someone certified by the Western Chapter of the International Society of Arboriculture.

Correcting Soil Problems

Fills - The flared bases (root crowns) and trunks of trees buried during construction should be exposed by careful excavation down to the original soil grade and out to several feet. Moist soil in contact with the bark of the trunk usually leads to decay. Slope the soil away from the tree so that water does not collect near the trunk and try to provide some drainage. A retaining wall may be needed to keep soil away from the root crown and trunk. You can tell that the soil level around your oak has been raised if the trunk does not flare out as it enters the soil.

Compaction - Soil compaction displaces much of the natural air space in the soil, reducing the amount of air (oxygen) available to the roots. Oxygen is critical for the uptake of the water and minerals necessary for tree growth and survival. Oaks growing in compacted soil may benefit from increasing the availability of oxygen to the roots. The best way to do this is to eliminate or curtail activities around the tree which cause compaction, followed by the addition of several inches of organic mulch to the drip zone. This will gradually improve soil structure and aeration, while helping to prevent further compaction. Avoid placing mulch directly against the trunk.

Several methods may be used to temporarily improve soil aeration. One method involves drilling holes 1-3 inches wide, 12 inches deep, and 1-3 feet apart around the tree out to the drip line. Holes may be filled with coarse sand or pea gravel or left open. It may be necessary to repeat every two to three years. Another method involves the injection of air under pressure into holes to fracture and lift the hardened soil, allowing air penetration. Holes can also be made by injecting water under high pressure via a hollow tube into the soil. The water jet loosens and expels soil particles as it is inserted into the ground.

Pavement - Where practical, remove asphalt and concrete pavement within the drip line and replace with permeable materials like organic mulch, gravel, brick, or stone set in sand.

Inspecting Your Tree for Health and Hazard Potential

Signs of Advanced Decline or Decay

- Thin, sparse foliage
- Poor growth
- Yellow, undersized leaves
- Dead branches and limbs in the upper canopy
- Wilted, brown leaves during spring and summer
- Many short shoots growing on trunk and branches
- Mushrooms at tree base or on the roots in the fall or early winter
- Conks - shelf-like mushrooms on trunk
- Cavities in trunk

- White, fan shaped mats of fungus under the bark at the soil line.
- Soft, punky wood
- Wet, oozing areas on the bark

Proper health and hazard inspection is difficult to do. It requires training, experience, and sometimes elaborate procedures to be reliable. A thorough tree inspection may involve exposing the large, supporting roots originating at the base of the trunk (root crown). This requires the careful removal of soil from a distance of 2 - 3 feet around the root crown to a depth of 12-18 inches or to the original grade if fill soil has been placed around the tree. Soil excavation and root-crown inspection are best done by a consulting arborist.

Oaks with extensively decayed roots should be removed for safety; those in the early stages of decay can be treated. Carefully expose infected roots and remove diseased portions. Cut the bark back until healthy wood is found. Dispose of all diseased roots and bark. Allow the exposed roots to dry for several months. You may wish to construct a retaining wall around the perimeter of the excavation to keep the soil away from the exposed roots. Try to provide drainage to keep rainwater from collecting in the well. The soil can be replaced before winter. Otherwise, the roots can be left exposed. Although this is not a cure, it will slow the progress of the disease-producing organisms, prolonging the life of the tree. For this treatment to be helpful, all further watering near the trunk must be stopped.

Successful Development Around Oaks

Successful development around oaks depends on careful planning and construction. For this to happen, everyone involved in the development process must recognize that tree health suffers when roots are destroyed or soil conditions are altered.

When oaks die, property values drop and removal costs are incurred. Prudent development can ensure a more attractive and more valuable setting.

Further Reading

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Other Resources:

Western Chapter International Society America, Certification Committee, P. O. Box 424, St. Helena, CA 94574. (707) 963-7578, for lists of Certified Arborists.

University of California Cooperative Extension, Natural Resources Program, 163 Mulford Hall, Berkeley, California, 94720. (415) 642-2360.

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Revised, 3/4/91